Coordination and Data Management of the International Arctic Buoy Programme (IABP)

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LONG-TERM GOALS

To maintain a research quality database of direct measurements and analyzed fields of surface air temperature (SAT), sea level pressure (SLP), ice motion and other geophysical quantities in the Arctic Basin using drifting buoys.

OBJECTIVES

To coordinate resources to maintain a network of drifting buoys in the Arctic Basin that measure SLP, SAT and other geophysical quantities. To maintain a research quality database of these observations.

To study possible improvements in the analyzed geophysical fields. The data collected meet meteorological, climatological, and oceanographic requirements for both research and operational needs. Figure 1 shows the positions of buoys in October 2000, with the sea ice concentration map obtained from the National Center for Environmental Prediction underlayed.

APPROACH

Coordination of the IABP falls into the categories of information, resource management, and meeting planning. Information is primarily distributed via a monthly buoy position charts and by one-to-one correspondence. More general information is available in a published brochure. Resource management is focused on matching buoy hardware and deployment opportunities to the requirements of maintaining the buoy network.

Data management consists of analyzing the available buoy data and producing data sets of ice motion, SLP, and SAT for research use. These data sets are described in annual reports, and are archived at the World Data Center, but primary distribution of the data sets has been through the Polar Science Center (PSC) via anonymous ftp. These data and other research products of the IABP are available on the World Wide Web at http://iabp.apl.washington.edu/.

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WORK COMPLETED

Our recent efforts to improve the IABP databases have been directed towards producing a new SAT analysis which combines data from the buoys with data from land stations using the objective analysis procedure, optimal interpolation. This new SAT analysis is documented in a paper that has been published in the *Journal of Climate* (Rigor, et al., 2000). The data has been incorporated into a Global SAT climatology (Jones, et al. 1998) and has been included on the Environmental Working Group, Arctic Ocean Meteorology and Sea Ice digital atlases.

RESULTS

Using this SAT dataset, variations in SAT were studied. We show that there was a 2°C/decade warming over the eastern Arctic Ocean as well as a lengthening of the melt season of the sea ice from 1979 – 1997 (Figure 2). We show that these variations in SAT are related to the Arctic Oscillation (Thompson and Wallace, 1998), which accounts for more than 50% of the trends in SAT over much of the Arctic region.

IMPACT/APPLICATIONS

The buoy data meet meteorological, climatological and oceanographic requirements for both research and operational components internationally, and thus the buoy program has gained widespread support. High latitude countries use the data to forecast weather. The data are essential in monitoring climate, assessing the environment, validating model simulations of atmospheric temperature and pressure and ice drift. Specifically, operational weather prediction programs in the circumpolar countries benefit from the surface pressure and temperature data that the network provides. The archived data have been used to study ice motion and dynamics in the Basin. The pressure data are used to estimate the mean surface wind, which can drive sea ice models, and for input into climate change studies.

Recent research using the IABP databases includes back and forward trajectory analysis to study the origins and fate of samples taken from the sea ice. Given the current location of a piece of ice, using the IABP databases, we can trace its probable history, and predict its future deposition. Results of these studies have been published or presented in collaboration with various colleagues.

The data from the IABP has been instrumental in documenting climate change in the Arctic. Results on decadal scale variability show the Arctic Basin to be a center for extraordinarily large change. Using IABP data, Walsh et al (1996) compared two eight-year records of sea level pressure (SLP), 1979-86 and 1989-94, and found a 4 mb difference between the means of these two periods. Rigor, et al. (2000) studied the inter-annual trends in SAT (Figure 2) and the length of the melt season over the Arctic Ocean, and showed that these variations are related to the Arctic Oscillation and the changes in circulation.

TRANSITIONS

Walsh et al. (1996) and Rigor et al. (2000) have studied the changes in SLP and SAT in the Arctic using the buoy observations. The warming trends at the surface and the cooling trends noted in the

Microwave Sounding Unit (MSU) data aloft imply changes in atmosphere stability. A study of the corresponding changes in atmospheric stability is in order.

RELATED PROJECTS

1- John M. Wallace (University of Washington) and I are studying interannual variation in the IABP data in relation to the Arctic Oscillation.

2- Roger L. Colony (International Arctic Research Center, University of Alaska Fairbanks) and I are studying the annual cycle of SLP, SAT and ice motion.

3- Using the buoy data, the interannual variability in the transport pathways of sea ice produced in the Siberian Seas is being quantified in collaboration with Stephanie Pfirman (Columbia University).

4- In collaboration with Norbert Untersteiner (University of Washington) and Roger Colony a CD showing animations of the buoy data is in preparation. The intention for this new CD is to make a product that could be used as a teaching aid to study air, sea and ice interaction

5- We have been working with Florence Fetterer (National Snow and Ice Data Center) to incorporate the IABP SAT and ice motion fields on the Environmental Working Group, Arctic Ocean Meteorology, and Sea Ice digital atlases.

6- We have been working with Estelle Couture (Marine Environmental Data Service, Canada) to produce a CD collecting the first 20 years of IABP data.

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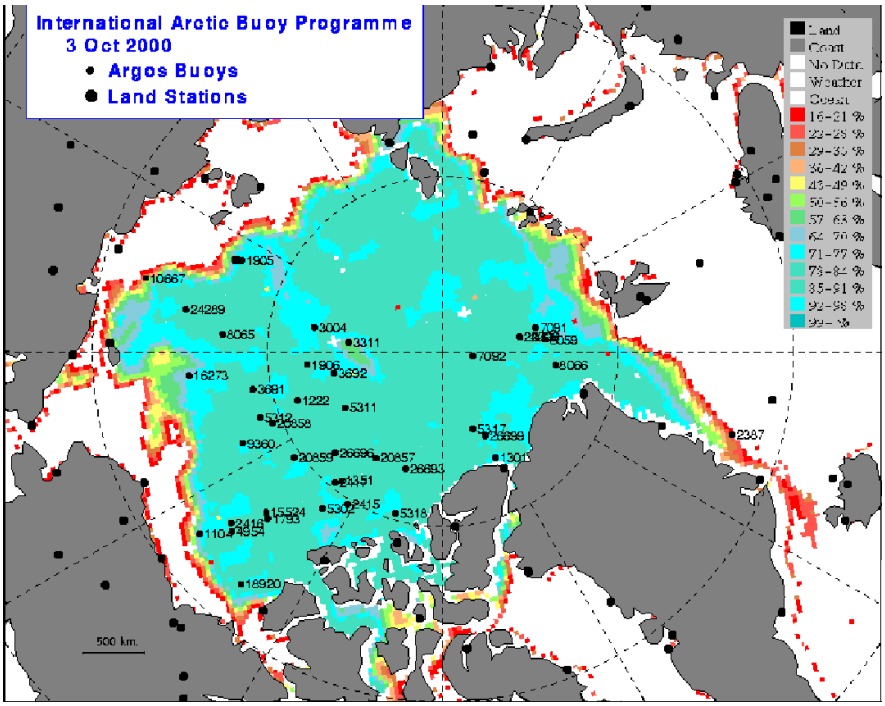

Figure 1. Position of buoys on October 3, 2000 is shown by the black dots. The NCEP sea ice concentrations analysis is also shown.

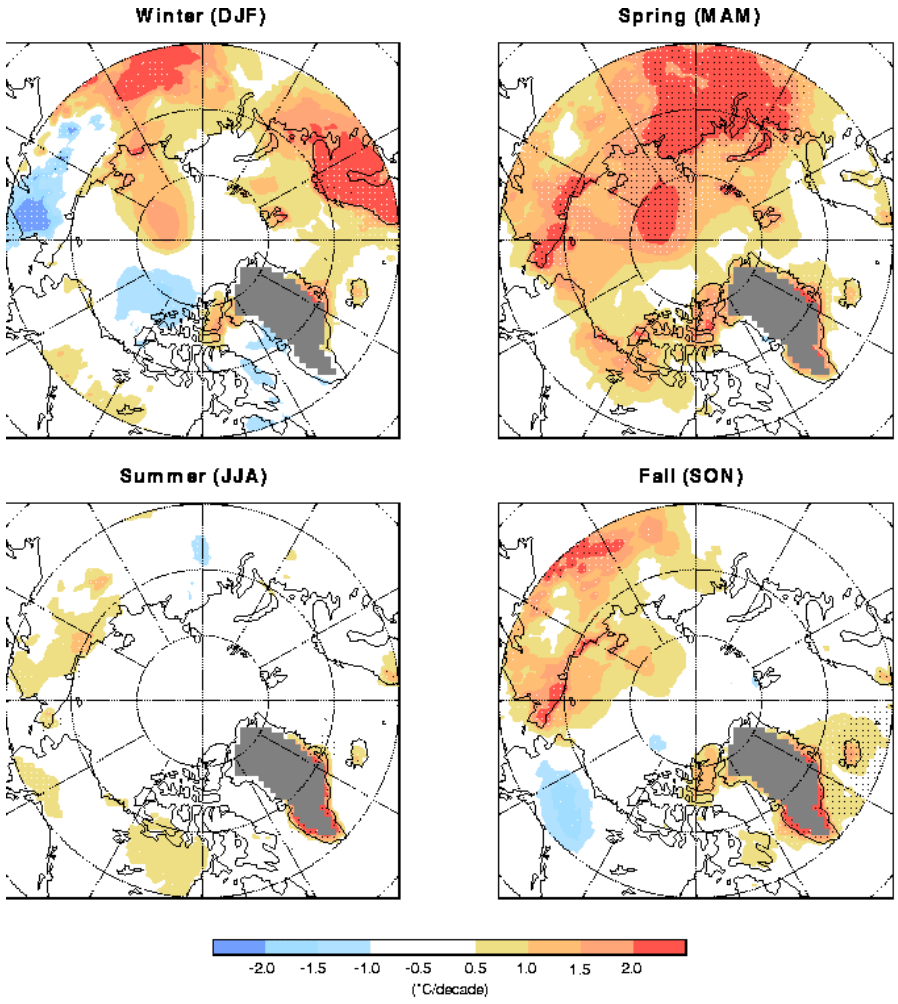

Figure 2. Trends in surface air temperature from 1979 – 1997 estimated from the IABP/POLES surface air temperature analysis. Trends in grid cells that are significant at the 95% level are marked with small white dots; trends that are significant at the 99% level are marked with small black dots. A trend of +1°C/decade is found during winter in the eastern Arctic Ocean, but a trend of –1°C/decade is found in the western Arctic Ocean. During spring, almost the entire Arctic shows significant warming trends. In the eastern Arctic Ocean this warming is as much as 2°C/decade.